# CHLORINATED FLUOROCARBONS

CAS Registry Number: 76-13-1 (Freon-113) $CCl_2FCClF_2$

Molecular Formula: $C_2Cl_3F_3$

Chlorinated fluorocarbons (CFC) are organic compounds analogous to hydrocarbons in which the hydrogen atoms have been replaced by chlorine and fluorine. The properties tabulated below are for CFC-113, a common CFC which has been studied extensively. CFC-113 is a colorless, volatile gas with a nearly odorless smell. It is soluble in alcohol, ether, and benzene (Merck, 1989).

**Physical Properties of CFC-113**

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| Synonyms: | CFC-12; CFC-113; Freon-113; chlorofluorocarbon, chlorotrifluoromethane; dichlorodifluoromethane (Fluorocarbon-12); trichlorofluoromethane; dichlorofluoromethane; chlorofluoromethane; chloropentafluoroethane |
| Molecular Weight: | 187.38 (Freon-113) |
| Boiling Point: | 47.7 °C |
| Melting Point: | -36.4 °C |
| Vapor Density: | 6.5 (air = 1) |
| Density/Specific Gravity: | 1.5635 at 25/4 °C (water = 1) |
| Vapor Pressure: | 284 mm Hg at 20 °C |
| Log/Octanol Water Partition Coefficient: | 3.16 |
| Water Solubility: | 170 mg/l at 25 °C |
| Henry's Law Constant: | 0.526 atm-$m^3$/mole at 25 °C |
| Conversion Factor: | 1 ppm = 7.66 mg/$m^3$ |

(Howard, 1990; HSDB, 1993; Sax, 1987)

## SOURCES AND EMISSIONS

A. Sources

Chlorinated fluorocarbons are widely used refrigerants. Other common uses include as foam blowing agents, solvents, chemical intermediates in the manufacture of polymers and resins, and aerosol propellants (HSDB, 1993).

The primary stationary sources that have reported emissions of CFC-113 in California include

manufacturers of medical instruments and supplies, electronics manufacturers, and manufacturers of guided missiles and space vehicles. The primary stationary sources that have reported emissions of other chlorinated fluorocarbon compounds are manufacturers of miscellaneous plastic products, manufacturers of ophthalmic goods, and manufacturers of electronic components and accessories (ARB, 1997b).

B. Emissions

The total emissions of CFC-113 from stationary sources in California are estimated to be at least 2.4 million pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588). Emissions of other chlorinated fluorocarbons from stationary sources in California are estimated to be at least 9.6 million pounds per year, also based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

CFC-113 is not known to occur naturally (Howard, 1990).

## AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of chlorinated fluorocarbons.

## INDOOR SOURCES AND CONCENTRATIONS

No information about the indoor sources and concentrations of chlorinated fluorocarbons was found in the readily-available literature.

## ATMOSPHERIC PERSISTENCE

CFCs do not contain hydrogen and do not react with the hydroxyl (OH) radical, nor do they photolyze in the troposphere. The only loss process for CFCs from the troposphere is by transport to the stratosphere, where they will encounter short-wavelength ultraviolet radiation as they move up through the stratospheric ozone layer. The CFCs are photolyzed in the stratosphere to release chlorine atoms. The tropospheric lifetimes of the CFCs due to transport into the stratosphere are typically 50 to greater than 150 years (WMOGRMP, 1992).

## AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer health effects, chlorinated fluorocarbons contributed to the total hazard index in 17 of the approximately 89 risk assessments reporting a total chronic hazard index

greater than 1 (OEHHA, 1996b).

**HEALTH EFFECTS**

Probable routes of human exposure to chlorinated fluorocarbons are inhalation and ingestion.

Non-Cancer: CFCs are central nervous system depressants. They can also sensitize the heart to the arrhythmogenic effects of epinephrine. Warning symptoms include palpitations and dizziness. Symptoms of moderate exposure include headache, nausea and vomiting, confusion, and drunkenness. More severe exposure might result in coma or respiratory arrest. A number of deaths, presumably caused by ventricular fibrillation, have been reported following abusive sniffing of CFCs (Olson, 1994). One infrequently used CFC, dichlorofluoromethane, causes liver damage in repeatedly exposed animals.

A chronic non-cancer Reference Exposure Level (REL) of 700 micrograms per cubic meter is listed for CFCs in the California Air Pollution Control Officers Association Air Toxics "Hot Spots" Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoint considered for chronic toxicity is the nervous system (CAPCOA, 1993). The United States Environmental Protection Agency (U.S. EPA) has established a Reference Concentration (RfC) for chloro-difluoroethane of 50 milligrams per cubic meter ($mg/m^3$). The U.S. EPA RfC for chlorodifluoromethane is also 50 $mg/m^3$ and was set on the basis of increased kidney, adrenal and pituitary weights and reduced maternal weight gain in the rat. The U.S. EPA estimates that inhalation of these concentrations or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects (U.S. EPA, 1994a).

In rats, inhalation of chlorodiflouromethane at very high levels during pregnancy resulted in birth defects (U.S. EPA, 1995a).

Cancer: Chlorodifluoromethane caused a slight increase in cancer in animals exposed to a very high level. The U.S. EPA has not classified any CFC as to its carcinogenic potential (U.S. EPA, 1995a; NTP, 1994a). The International Agency for Research on Cancer has reviewed the evidence for the carcinogenicity for chlorodifluoromethane, 2-chloro-1,1,1-trifluoroethane, and chlorofluoromethane and has classified them in Group 3: Not classifiable (IARC, 1987a).